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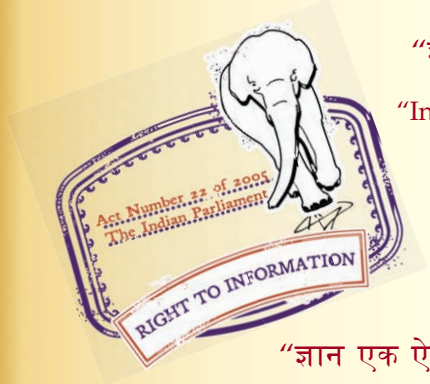



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"Knowledge is such a treasure which cannot be stolen"

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IS : 3649 - 1966

*Indian Standard*

( Reaffirmed 2001 )

# SPECIFICATION FOR CLUTCH FACING FOR AUTOMOTIVE TRANSMISSION

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**BUREAU OF INDIAN STANDARDS**
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

**Gr 3** *November* 1966

# *Indian Standard*

# SPECIFICATION FOR CLUTCH FACING FOR AUTOMOTIVE TRANSMISSION

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# SPECIFICATION FOR CLUTCH FACING FOR AUTOMOTIVE TRANSMISSION

## 0. FOREWORD

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 7 July 1966, after the draft finalized by the Automotive Vehicles Sectional Committee had been approved by the Mechanical Engineering Division Council.

**0.2** The manufacture of automobile components has been progressing at a very fast rate and in order to assist in production of quality products, this standard has been developed. It specifies two grades of material and depending upon the application, the grade of the material is to be chosen. It is preferable, if new applications are envisaged to consult the manufacturer beforehand to obtain his advice on the best type of material to be used.

**0.3** The tests and coefficient of friction have been included in this standard with a view to establishing control over the quality. It should be recognized that the values of coefficient of friction obtained for this purpose are not necessarily applicable for the purpose of the design.

**0.3.1** Two different methods of test for conducting the friction test have been specified (*see* Appendices A and B). As no correlation has been established on these methods, the manufacturer should specify the type of method he proposes to adopt for the testing of the facings at the time of the enquiry and order.

**0.4** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## 1. SCOPE

**1.1** This standard covers the requirements of automotive clutch facings for single plate and multiplate applications under dry conditions. Bonded facings are excluded from the purview of this standard.

*Rules for rounding off numerical values (*revised*).

## 2. MATERIALS

**2.1** The clutch facings shall be made from heat-resisting base material impregnated and stabilized using suitable bonding media.

## 3. TYPES

**3.1** The clutch facings shall be of the following two types:

Type A—Solid woven or plied fabric with or without metallic reinforcement.

Type B—Moulded and semi-moulded compound.

## 4. PREFERRED DIMENSIONS AND PERMISSIBLE DEVIATIONS

**4.1** The preferred dimensions for clutch facings shall be as given in Table 1.

**TABLE 1 PREFERRED DIMENSIONS FOR CLUTCH FACINGS**

All dimensions in millimetres.

| | |
|---|---|
| Preferred outside diameter | 120, 125, 130, 135, 140, 145, 150, 155, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 325, 350 |
| Preferred inside diameter | 80, 85, 90, 95, 100, 105, 110, 120, 130, 140, 150, 175, 200 |
| Preferred Thickness | 3, 3·5, 4 |

**4.2** The permissible deviations from the specified dimensions for clutch facings shall be as given below:

| a) *Outside Diameter* mm | *Permissible Deviation* mm |
|---|---|
| 120 to 160 | 0<br>−0·5 |
| 170 to 300 | 0<br>−0·8 |
| Over 300 | 0<br>−1·0 |

| b) *Inside Diameter* mm | *Permissible Deviation* mm |
|---|---|
| 80 to 110 | $+0{\cdot}5$ 0 |
| 120 to 150 | $+0{\cdot}8$ 0 |
| Over 150 | $+1{\cdot}0$ 0 |

| c) *Thickness* | *Permissible Deviation* |
|---|---|
| All sizes | $\pm 0{\cdot}1$ mm |

**4.3 Hole Location** — The number of holes and their positions on the clutch facing have not been specified and may vary according to application. The amount of residual material between the edge of the drilled countersunk hole and the outer or inner edge of the facing shall be not less than half of the rivet head diameter.

**4.4 Rivet Holding Land** — The rivet holding land in drilled facing shall be not less than 1·45 mm nor more than half of the thickness of the facing. Land shall be measured from the deepest portion of the countersunk hole, irrespective of the angle of the rivet head (*see* Fig. 1).

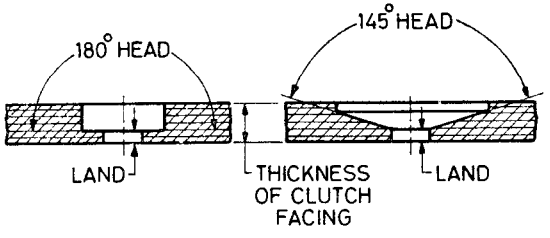



FIG. 1 RIVET HOLDING LAND

**4.5 Parallelism** — A small difference in thickness from point to point is permissible in individual facings. This difference shall not exceed 0·08 mm value included in the general tolerance on thickness of the facing.

## 5. FREEDOM FROM DEFECTS

**5.1** The facings shall be free from defects such as cracks, cuts and superficial flaws.

**5.2** The facings shall lie flat after riveting to the plate and shall conform to the tolerance of parallelism given in **4.5**.

## 6. SAMPLING

**6.1** The size of sample and details of conditions in which the test may be carried out at manufacturer's works may be agreed upon between the manufacturer and the buyer.

## 7. TESTS

**7.1** From the samples selected, test specimens shall be cut for conducting the normal friction test and wear test. The test specimens shall be tested on any suitable testing machine, as agreed to between the supplier and the purchaser. The machine may be of the scale dynamometer type using either constant load or constant torque on the specimens. Descriptions of such testing machines and test methods that may be adopted for the determination of the coefficient of friction and rate of wear are given in Appendices A and B.

**7.2 Normal Friction Test** — It shall be carried out as described in **A-2.2.1** or **B-2.3.2**. The temperature at the interface during this test shall be $150° \pm 10°C$. The average values of coefficient of friction as determined by normal friction test shall be within the range 0·25 to 0·35 for the facings of both Type A and Type B.

**7.3 Wear Test** — It shall be carried out as described in **A-2.2.2** and **B-2.3.3**. The manufacturer shall declare the wear properties of the particular quality of clutch facing in terms of loss in volume per unit of work done, for example, $cm^3$/kWh or $cm^3$ per 100 horsepower hour. The wear when determined by this test shall not be more than the value declared by the manufacturer prior to supply which shall not be more than 15 $cm^3$ per 100 horsepower hour.

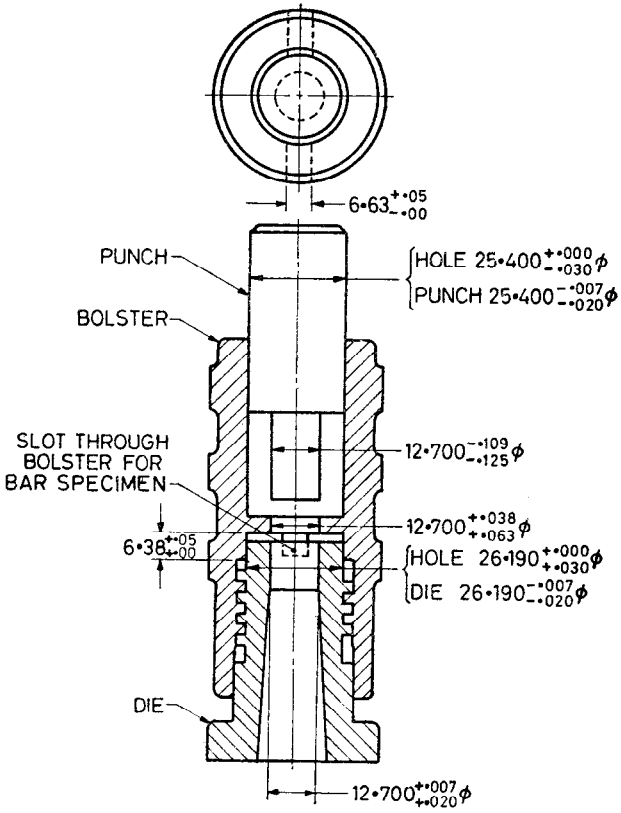
**7.4 Shear Test** — The shear test shall be applicable to the facings of both Type A and Type B. The test shall be carried out on four specimens, two cut with their length along the sheet length and two with their lengths across the sheet length. The details of shear test are given below.

**7.4.1** *Test Specimens* — Each specimen shall be a rectangular bar $6·35 \pm 0·25$ mm wide and not less than 30 mm long. The thickness of the test specimen shall be the thickness of the clutch facing under test.

**7.4.2** *Apparatus* — A punch, die and bolster assembly conforming to dimensions shown in Fig. 2 and a suitable compression testing machine, capable of developing a load of over 2 000 kgf shall be used.

**7.4.3** *Conditioning of Specimens* — When specimens are required to be conditioned, they shall be subjected to an atmosphere of $65 \pm 5$ percent relative humidity at a temperature of $27° \pm 2°C$ for not less than 24 hours (*see* IS : 196-1966*). Every specimen shall be tested as soon as possible after removal from the controlled atmosphere, and in any case, the test shall be started before three minutes have elapsed.

*Atmospheric conditions for testing (*revised*).




All dimensions in millimetres.

FIG. 2 SHEARING STRENGTH, FLATWISE TEST SET-UP

**7.4.4** *Procedure* — The test specimens shall be conditioned as in **7.4.3**. The thickness and the width of the specimen shall be measured to the nearest 0·03 mm. The specimen shall be placed in the assembly with the unmachined face upwards, the die being screwed home against the specimen in the bolster. The load shall be applied evenly to the specimen by means of the punch at such a rate that the final value at which the specimen shears is reached in 15 to 45 seconds from the time of initial application of the load.

**7.4.5** *Calculation and Report* — The shearing strength shall be calculated as follows:

$$\text{Shearing strength, kgf/cm}^2 = \frac{W}{2BDK}$$

where

$W$ = load in kgf at fracture,

$B$ = width in cm of specimen,

$D$ = thickness in cm of specimen, and

$K$ = a factor with a value 1·048 introduced to allow for the curvature of the sheared surface.

The arithmetic mean of the two values in direction along the sheet length and two values in direction across the sheet length should be calculated and lower of the two reported as the shearing strength of the sheet.

**7.4.6** The minimum shear strength for the two types of clutch facings, when determined according to **7.4.5**, shall be as follows:

| | *Shear Strength, Min* |
|---|---|
| Clutch Facing Type A | 75 kgf/cm$^2$ |
| Clutch Facing Type B | 50 kgf/cm$^2$ |

## 8. MARKING

**8.1** The clutch facing shall be clearly marked with its type and name, initials or trade mark of the manufacturer. Where applicable, the reference number or part number designated by the purchasing party may also be marked.

### 8.2 BIS Certification Marking

The product may also be marked with Standard Mark.

**8.2.1** The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

## 9. PACKING

**9.1** The clutch facings shall be packed in accordance with the best trade practice. A package shall normally contain two facings. Other arrangements are permissible to meet the requirements of original equipment supplies and bulk supplies.

# APPENDIX A

(*Clauses* 0.3.1 *and* 7.1)

## DESCRIPTION OF THE MACHINE AND METHOD OF DETERMINING COEFFICIENT OF FRICTION, CONSTANT LOAD METHOD

### A-1. TESTING MACHINE

**A-1.1** This machine is designed to measure the coefficient of friction under a constant load applied by means of an air-hydraulic cylinder forcing the torque head carrying the friction disc against the sample pieces.

**A-1.2** The machine consists essentially of the following parts:

a) A *sample head* which is carried on a spindle running in water-cooled frictionless bearings and driven by an electric motor of 11·25 kW (15 hp) through V-belts.

b) A friction disc which is mounted on a jacketed torque head.

c) A torque head fitted with an arm which transfers the resisting torque to a hydraulic cylinder which transmits the force required to counter the torque, to the recorder. The torque head is supported on frictionless bearings so that the force spent in the initial sliding action is negligible for all practical purposes. The torque head has arrangement for circulation of water thus enabling tests to be carried out at varying temperatures. The air pressure is variable so that different loads can be supplied to simulate load conditions which are experienced in various types of brake systems.

d) The ancillary equipment consists of pressure gauges, starters, isolators, timers, automatic load cut-off, load indicator and automatic load/torque indicator.

**A-1.3** The general specifications of the testing machine and test specimens are as follows:

| | |
|---|---|
| Mean area of friction surfaces of the friction disc (the surface finish shall be 100 to 150 microns) | 231 $cm^2$ |
| Material for friction surface of friction disc | Cast steel |
| Speed of the sample head | 720 rev/min |
| Size of test pieces | 25·4 × 25·4 mm |
| Thickness of test pieces | Original thickness of sample but not less than 5 mm |
| No. of test pieces | 3 |
| Friction pressure of test pieces | Variable from 3·5 to 5 $kgf/cm^2$ |
| Temperature of friction disc for normal test | 100°C |

## A-2. TESTING METHOD

**A-2.1** Three test pieces of 25·4 × 25·4 mm are placed securely in the slots of the sample head with the working surfaces facing the friction disc. The torque head is moved forward so that the friction disc just makes contact with the samples and is then withdrawn very slightly. Water is circulated and the machine started and when the full-load speed has been attained, the predetermined load is applied to the torque head by means of the air-hydraulic cylinder and simultaneously the automatic timer is started, which cuts off the load after 20 minutes.

**A-2.2** A continuous record of the load/torque ratio is made by the automatic recorder. The coefficient of friction is calculated from the chart readings at $2\frac{1}{2}$ minute intervals. The thicknesses of the test pieces are measured before the start of the test and again after the completion of one cycle consisting of three tests, namely normal, heat and normal. The loss in thickness measures the wear due to the continuous rubbing against the friction disc for the duration of the tests.

**A-2.2.1** *Normal Friction Test* — The normal friction test with the test machine shall be conducted on the three samples for 20 minutes with a load of 3·515 kgf/cm$^2$ with cooling water circulating in the torque head so that temperature of the friction disc shall not be more than 100°C. During the first few minutes of the test the surfaces of the test pieces shall be normalized by rubbing action on the surface so as to obtain uniform surface giving total contact with the friction disc. This shall be indicated by an initial rise to a peak value of coefficient of friction and gradual fall to a normal value when the surfaces of the test specimens are bearing fully on the friction disc. For the test purposes the values of coefficient of friction registered during the bedding period of the sample shall be ignored. The average value of the coefficient of friction shall be calculated over the steady portion of the graph. The average value of coefficient of friction shall conform to the values given in **7.2**.

**A-2.2.2** *Wear Test* — The thickness loss suffered by the three test specimens after the test described at **A-2.2.1** shall be measured. For each test the rate of wear shall be specified in terms of unit loss in volume per unit of work done, for example, in cm$^3$/kWh or cm$^3$ per 100 horsepower hour.

# APPENDIX B

(*Clauses* 0.3.1 *and* 7.1)

## DESCRIPTION OF THE MACHINE AND METHOD OF DETERMINING COEFFICIENT OF FRICTION, EVALUATION 'SCALE' RIG METHOD

### B-1. EVALUATION 'SCALE' RIG

**B-1.1** This simple rig has been developed essentially to assess the performance of friction materials in the laboratory. In the present context, however, it is intended to be used as a quality control equipment for both the manufacturers and the industrial consumers of friction materials.

**B-1.2** The machine is capable of measuring the coefficient of friction under constant torque condition. The torque is predetermined and is maintained constant automatically throughout the test by pneumatic control nozzles.

**B-1.3** The machine consists essentially of the following parts:

a) *Scale Friction Disc* — Runs at constant speed through a belt drive from an electric motor. The disc is thermally insulated behind the unused face.

b) *Loading Head* — It is supported in ball bushing to allow axial movement which is provided by a piston loaded by compressed air acting on a rolling diaphragm contained in a cylinder. Constant torque conditions are maintained automatically by control nozzles contained in a throttle box which is located below the torque arm.

c) *Instrumentation* — The rig is equipped with chromel/alumel thermocouple for measuring interface temperature. The load pressure, which is a measure of the friction level, and the temperature are both recorded on a dual pen recorder. This is desirable since it is then possible to relate friction level to surface temperature as a permanent record.

**B-1.4** The general specifications of the testing machine and test specimens are as follows:

| | |
|---|---|
| Friction disc speed | 1 550 rev/min |
| Area of test samples | 1 735 $mm^2$ |
| Number of test pieces | 6 |
| Size of test pieces | 20 mm × 20 mm approximately to form two subtended arcs of 105° each of outside diameter 78 mm and inside diameter 47 mm |
| Effective length of torque arm | 304·8 mm |

## B-2. TEST PROCEDURE

**B-2.1** The test segments are made up of six pieces of material about 20 mm × 20 mm square so that it is possible to cut reasonably flat specimens from the curved lining. The test pieces are cut at random from the lining segment ensuring that they were at least 20 mm from any edge. They are cut with sides tapering and three specimens are pressed into each side of sample holder. The friction surface is ground flat prior to testing.

**B-2.2** To operate the machine, the disc is kept running and the specimen loaded by switching on the air supply. A predetermined torque, depending on the control load, is supplied by the torque arm. Should there be any change in friction, the degree of throttling will alter, producing a new loading pressure to maintain a constant friction torque.

**B-2.3** A continuous record of load pressure which is a measure of friction level, and interface temperature is made by the dual pen recorder on the charts. A calibration chart is provided to find out exact coefficient of friction during any particular test. The thickness of specimen is measured before and after the test, and wear rate is derived.

**B-2.3.1** *Test Schedule and Measurements*

**B-2.3.1.1** *Bedding* — One hour duration on a 30-second cycling time and 4-second braking time, and 2·3 kgf control load, the maximum disc temperature should not exceed 150°C.

**B-2.3.1.2** *Post bedding check* — Five successive applications from 1·8 kgf to 3·6 kgf control load for 5-second duration. Control load is increased by 0·45 kgf in each application. Disc temperature should be 150°C before each application. This test is to be followed by five stops at 3·6 kgf control load and 5 second duration, all starting from a disc temperature of 150°C.

**B-2.3.1.3** *First wear measurement* — The specimen holder is removed from the rig and examined. Minimum bedding of 90 percent is acceptable. If bedded, the total thickness of mounted specimens at their centres (6 reading) shall be measured. If not bedded, the specimens should be replaced and the above procedure followed for 15 minutes. All measurements shall be made when cold.

**B-2.3.2** *Normal Friction Test* — With 2·7-kgf control load, 30 applications of 3-second duration are made on a 10-second time cycle. The interface temperature should not exceed 150°C. The average value of coefficient of friction shall be calibrated from the graph over the steady portion of the readings. This value should conform to the values given in **7.2.**

**B-2.3.3** *Wear Test* — The thickness loss suffered by the specimen, during the test described at **B-2.3.2** are measured (when facings are cold). For each test, the rate of wear is specified in terms of unit loss in volume per unit of work done, for example, in $cm^3$/kWh or $cm^3$ per 100 horsepower hour.

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